

# Measuring Direction: *Azimuth & Bearing*

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In a previous article, we discussed “North” in relation to using a compass. The next step in the process of proper use of a compass is the understanding of direction and how to measure it. The process includes some simple math but may seem difficult when learning from a narrative. Follow step by step, like assembling a child’s swing set (the difference being, the end product will not have left over parts!).

DIRECTION is the measurement of an angle on a horizontal plane from a base direction. It may be expressed in the form of an azimuth or a bearing. Each is described in detail. In either case there are four Cardinal Directions:

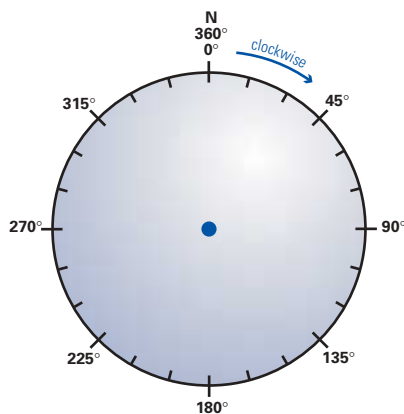


Figure 1  
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North, East, South, and West. They may always be expressed as Due North, Due East, Due South, and Due West. They correspond to  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$ , and  $270^\circ$ . The best tool for practicing the mathematics of angular direction is an inexpensive compass. Favor one with a full 360-degree circle. They are inexpensive and available in the school supply section of your local store.

## Azimuth

Direction expressed as an azimuth is measured starting at North, in a clockwise direction through a full  $360^\circ$  circle. It assumes that you, or the point you are measuring from on the map, are at the center of the circle. See Figure 1.

In Figure 2, “A” is an azimuth of  $45^\circ$ . That means that you are at the center of the circle, you hold your compass level (on a horizontal plane), point your North arrow at North and read clockwise, from the base direction (North),  $45^\circ$ . If you traveled along that line, you would be traveling on an azimuth of  $45^\circ$ . A measurement to line “B” produces

an angle or azimuth of  $90^\circ$ . “C” is  $225^\circ$  and “D” is  $315^\circ$ . Take your compass or protractor and practice.

## Bearing

It is fairly common to hear someone say, “Let me get my bearings.” They simply mean that they need a moment to gather their thoughts and organize the direction of their next action.

The formal measurement of bearings is also associated with the measurement

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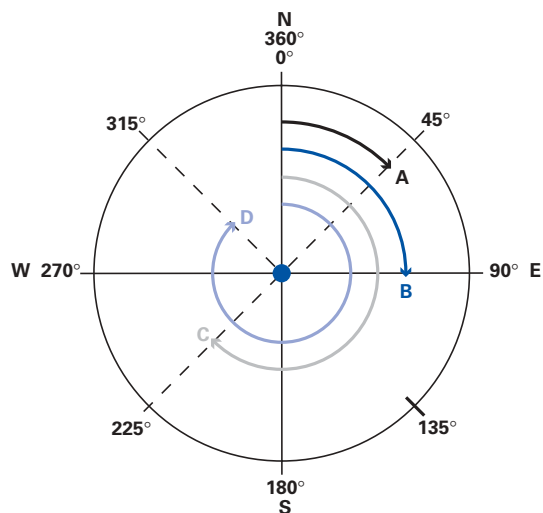


Figure 2

# Measuring Direction: *Azimuth & Bearing*

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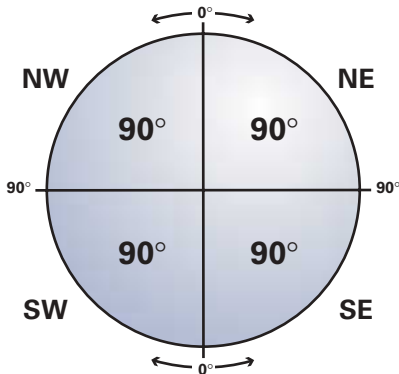


Figure 3

of angles. However, bearing is not associated with the expression of 360 degrees in a circle. It is associated with the four quadrants of a circle (NE, SE, SW, NW) and uses a base direction of either North or South. Measurements may not exceed 90 degrees since there are only 90 degrees per quadrant. See Figure 3.

Look at Figure 4. Bearing is measured from North to East or North to West. It is also measured from South to East and from South to West. Any one of the four measurements may range from 1 to 89 degrees, excluding cardinal directions.

Line "A" is expressed as North 45° West. This means that by positioning your compass pointing North, you hold it on a horizontal (level) plane, and measure the angle from the base direction of North. Line "B" is expressed as North 60° East. This may be abbreviated as N60° E. Lines "C" and "D" are measured from the baseline pointing South and are expressed as S15°E and S75°W. Practice with your protractor.

## Which Terminology Should I Use?

When should you express direction in azimuth and when should you use bearing? Either expression is technically correct. However, each is commonly associated with certain activities. If you are expressing a direction of travel, it is more likely to be understood if you use azimuth since everyone who had high

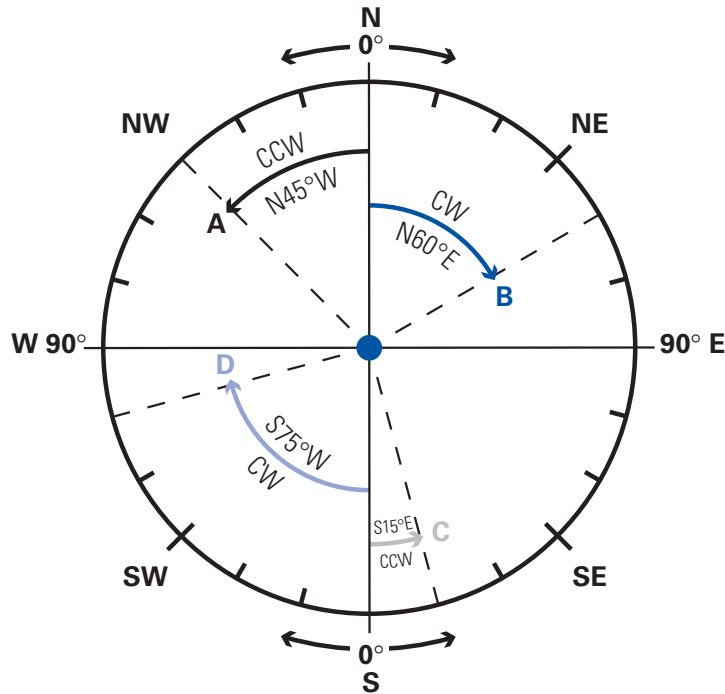


Figure 4

school geometry knows the 360 degrees of a circle. When fire towers report the direction of smoke, it is associated with the azimuth angle of measurement. So what about bearing? Look at the deed to your property. You will most likely see the description associated with the angular measurements of bearing. It will also have a reference point known to surveyors and associated with the Public Land or rectangular survey system (i.e., from known point "A" go N35°E for a described distance; from there go S75°E

for a described distance; continue N15°W and ultimately to the property line directions and distances around your property.) See Figure 5. There is another system of property location called "metes and bounds" but it will not be discussed in this article.

If azimuths and bearings are measurements of angles, any given angle may be expressed with either terminology. Consider this comparison in Figure 6. An azimuth of 45° equals a bearing of N45°E. An azimuth of 220° equals a bearing of S40°W, and an azimuth of 315° equals a bearing of N45°W. Try some examples of your own.

## Reverse Direction

There is one more concept needed to effectively use direction of travel. It is *back bearing* or *back azimuth*. If you wanted to trace your path back to where you came from, you would use the oppo-

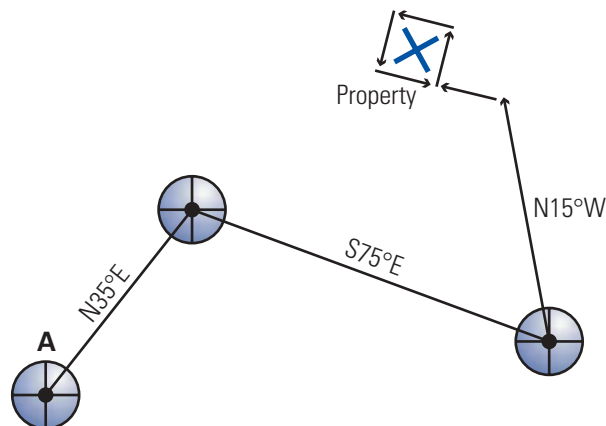


Figure 5

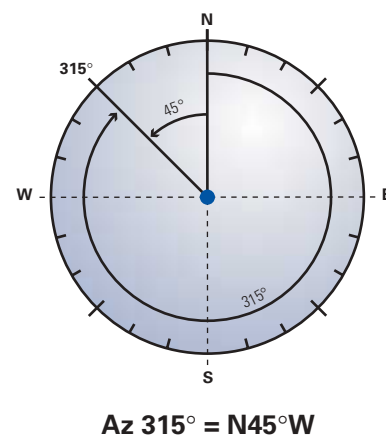
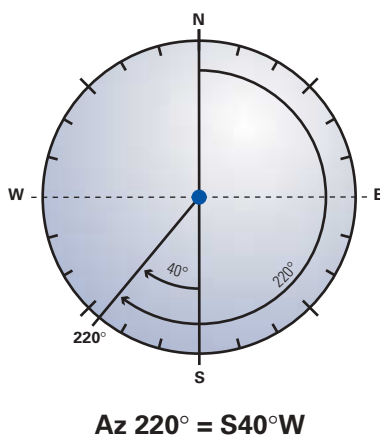
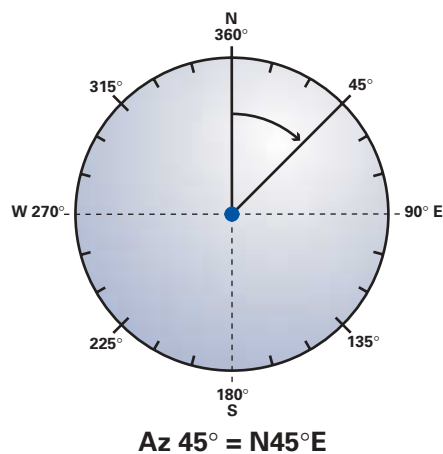


Figure 6

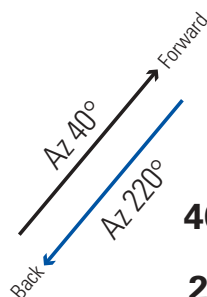
site of your direction of travel or a difference of 180 degrees. The computation of your back azimuth or back bearing will be important in a future article describing how to locate positions on a map.

The opposite direction of any straight-line travel is 180°. Therefore, modify your direction of travel by 180° and it will produce your “back” direction. For azimuth (Az.) angles of 180° or less, add 180 to your direction. For Az. angles of 180° or more, subtract 180 from your direction of travel. See Figure 7.

Example: If you are traveling in a direction of Az. 40°, add 180 and the opposite (or back Az.) direction is 220°. The back Az. of 285° is 285 minus 180 equals 105°. Try some examples of your own.

Computing the opposite direction of a bearing requires no math, only a juxtaposition of letters: N45°E equals S45°W and S30°E equals N30°W. Look at the examples in Figure 8 and then try some of your own.

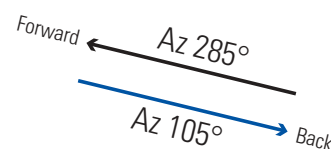
Another article in this series will explain how to use direction -- which you now know as an angle of measurement -- to locate positions such as smoke from a fire or your own location. All it takes is a compass, a map, and the knowledge you acquired from this article. 🗺️



$$40 + 180 = 220$$

or

$$220 - 180 = 40$$



$$285 - 180 = 105$$

or

$$105 + 180 = 285$$

Figure 7

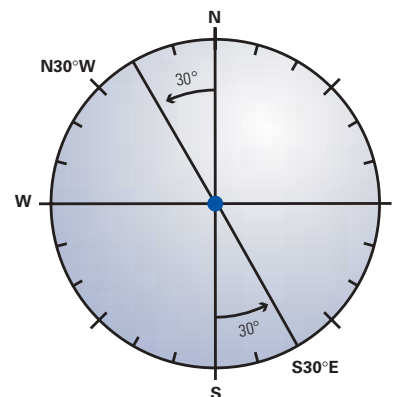
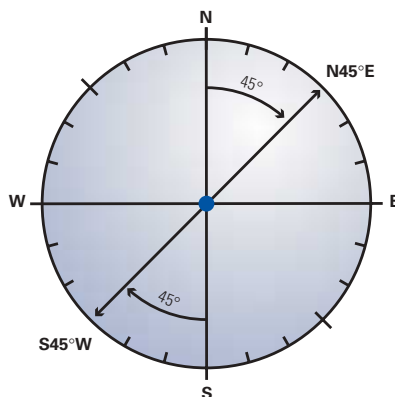


Figure 8

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